

## GUIDELINES AND EXAMPLES FOR MANUAL DATA INPUT OF LIQUID STORAGE TANKS

### **NOTE:**

IN ADDITION TO VOC EMISSIONS, YOU MUST CALCULATE AND REPORT EMISSIONS OF TOXIC AIR CONTAMINANT AND/OR OZONE DEPLETING COMPOUNDS (TAC/ODC) CONTAINED IN THE MIXTURE.

IF THE PRODUCT CONTAINS SOME TAC/ODC, REPORT THE VOC EMISSIONS ON ONE OF THE SPECIFIC TANK FORMS AND THE TAC/ODC FRACTIONS ON FORM TAC.

IF THE SOLVENT IN THE PRODUCT IS A PURE EXEMPT COMPOUND (NOT VOC) AND IS A TOXIC COMPOUND OR IS AN OZONE DEPLETER (i.e. METHYLENE CHLORIDE, PERCHLOROETHYLENE, 1,1,1-TRICHLOROETHANE, CFCs), REPORT ZERO VOC EMISSIONS ON FORM B4 OR B4U AND REPORT 100% TAC/ODC ON FORM TAC (SEE EXAMPLE 7).

The following examples will assist users in calculating and reporting manually calculated emissions from storage tanks on the correct forms.

### **Service Station With Fuel Storage and Dispensing System:**

The California Air Resources Board has identified four major contributors to gasoline storage and refueling losses. The composite emission factor is comprised of the sum of working losses ( $L_w$ ), breathing losses ( $L_s$ ), refueling losses ( $L_{rf}$ ), and spillage losses ( $L_{spill}$ ) on a per 1,000 gallons throughput basis (Mgal) and uncontrolled:

$$EF_{uncontrolled} = L_w + L_s + L_{rf} + L_{spill} = 9.5 + 1 + 10 + 0.7 = 21.2 \text{ lb/Mgal}$$

Through Phase 1 enhanced vapor recovery, the working (filling) losses are controlled by 98%. Breathing and refueling losses are controlled at 95%. Spillages are not controlled. Therefore,

$$EF_{controlled} = (9.5)(1-0.98) + (1)(1-0.95) + (10)(1-0.95) + 0.7 = 1.44 \text{ lb VOC/Mgal}$$

**THIS IS A DEFAULT VALUE.**

The total losses ( $L_T$ ) are a function of the controlled default emission factor and the throughput per 1000 gallons.

$$L_T = (EF_{\text{controlled}})(Q)$$

\* Gasoline contains benzene, a toxic air contaminant. The default emission factor for gasoline is 1% by weight of the VOC emissions and must be reported on Form TAC.

**Example 1:**

A service station delivered 200,000 gallons of gasoline last year. Calculate the annual emissions for the AER from the service station and include benzene TAC emissions.

$$L_T = (1.44 \text{ lb VOC/Mgal})(200 \text{ Mgal}) = 288 \text{ lb VOC/yr}$$

$$\text{TAC} = (0.01 \text{ lb benzene/lb VOC})(288 \text{ lb VOC/yr}) = 2.88 \text{ lb benzene/yr}$$

**Use Form B4 to input the data. Select the activity code of 2A from the drop down list, and select the unit code of 1000 gallons from its drop down list. Enter the throughput as 200. Make sure to check the box for TAC (benzene). The rule number is 461. Enter the application number associated with the permit. Enter 1.44 as the emission factor for organic gasses. Enter an emission factor of 0.0 for all other air contaminants and add the record. Go to Form TAC and add the data for the toxic component of benzene.**

For Diesel Storage and Dispensing the Organic Gas Default Emission Factor is:

$$\text{EF} = 0.028 \text{ lb/Mgal}, \text{ Q} = 200 \text{ Mgal}$$

$$L_T = (EF)(Q)$$

Enter an emission factor of 0.0 for all other air contaminants.

## **Underground Liquid Storage Tanks:**

For other underground tanks, assume that no standing losses (breathing losses) occur ( $L_s = 0$ ) because the insulating nature of the earth limits the temperature change. Underground tank is classified as fixed roof tank. Use the following equation to estimate working loss (total loss) for underground storage tanks.

$$L_w = 0.024 * M_v * P_{VA} * Q * K_N * K_P$$

Where:

$$L_w = \text{working loss, lbs/yr}$$

$$M_v = \text{average vapor molecular weight, lb/lb-mole}$$

*[See Appendix 1 for vapor molecular weight of selected materials]*

$$P_{VA} = \text{true vapor pressure of stored liquid at average liquid surface temperature, psia}$$

*[See Appendix 1 for true vapor pressure of selected materials]*

$Q$  = annual throughput, Mgal/yr

$K_N$  = turn over factor, dimensionless, dependent of annual throughput,  $Q$  (Mgal/yr), and tank capacity,  $C$  (Mgal).  $K_N$  is calculated as follows:

If  $Q/C \leq 36$  then  $K_N = 1.0$

If  $Q/C > 36$  then

$$K_N = \frac{180 * C + Q}{6 * Q}$$

$K_p$  = working loss product factor, dimensionless,  $K_p = 0.75$  for **crude oil** and  $K_p = 1.0$  for **other materials**

### Example 2:

A 25,000 gallon underground storage tank contains ethyl acetate and has been filled 4 times throughout the year and remains a constant 50 degrees F. What are the annual emissions?

$M_V$  = 88.1, lb/lb-mole

$P_{VA}$  = 0.831 psia

$Q$  = 100 Mgal/yr

$Q/C$  = 100/25 = 4, which is less than 36, therefore

$K_N$  = 1.0

$K_p$  = 1.0

$$L_w = (0.024 \text{ lb-mol/psia-Mgal})(88.1 \text{ lb/lb mol})(0.831 \text{ psia} * 100 \text{ Mgal/yr})(1.0)(1.0) \\ = 175.7 \text{ lb VOC/yr}$$

**Select Form B4 in the web-based application and enter the data on Form B4. Select the activity code of 2D from the drop down list, and select the unit code of 1000 gallons from its drop down list. Enter the throughput as 100. The rule number is 463. Do not check the TAC/ODC box. Enter the application number associated with the permit. Enter 1.757 (see below) as the emission factor for organic gasses. Enter an emission factor of 0.0 for all other air contaminants and add the record.**

$$EF = 175.7 \text{ lb VOC/yr}/100 \text{ Mgal/yr} = 1.757 \text{ lb/Mgal}$$

$$Q = 100 \text{ Mgal/yr}$$

## **Aboveground Small Liquid Storage Tanks:**

A small liquid storage tank is defined as a tank with a **storage capacity of less than 10,000 gallons and operated at ambient temperature and pressure**. Total emissions or losses from small tanks are equal to the sum of the working losses and standing losses:

$$L_T = L_W + L_S$$

Where:

$L_T$	=	total loss, lbs/yr
$L_W$	=	working loss, lbs/yr
$L_S$	=	standing loss, lbs/yr

### **Working Loss**

$$L_W = f * Q$$

Where:

$L_W$	=	working loss (lbs/year)
$f$	=	small tank filling loss factor, lbs/gal (See " <a href="#">Loss Factors for Small Storage Tanks</a> ")
$Q$	=	annual throughput, Mgal/yr

### **Standing Loss**

$$L_S = \frac{a * H * D^2}{(1 + b * H)}$$

Where:

$L_S$	=	standing loss, lbs/yr
$a, b$	=	small tank standing loss factors (See " <a href="#">Loss Factors for Small Storage Tanks</a> ")
$D^*$	=	tank diameter, ft
$H$	=	tank height, ft

\* For a **rectangular tank or square tank**, see supplemental instructions.

**Example 3:**

An aboveground 8,500 gallon storage tank with a diameter of 8 feet and height of 7 feet contains THF and undergoes 25 changes per year. It is vented to a control device that operates continuously at 90% control. Calculate the annual losses.

$$f = 4.019 \text{ lbs/gal (See " [Loss Factors for Small Storage Tanks](#) ")}$$

$$Q = 212.5 \text{ Mgal/yr}$$

$$a, b = 0.059, 0.062 \text{ (See " [Loss Factors for Small Storage Tanks](#) ")}$$

$$D^* = 8 \text{ ft}$$

$$H = 7 \text{ ft}$$

$$L_w = (4.019 \text{ lb/gal})(212.5 \text{ Mgal/yr})(1-0.90) = 85.4 \text{ lb/yr}$$

$$L_s = \frac{0.059 * 7 * 8^2}{(1 + 0.062 * 7)} (1 - 0.90) = 18.4 \text{ lb / yr}$$

$$L_T = 85.4 + 18.4 = 103.8 \text{ lb VOC/yr}$$

**Select Form B4 in the web-based application and enter the data on Form B4. Select the activity code of 2D from the drop down list, and select the unit code of 1000 gallons from its drop down list. Enter the throughput as 215.5. There is no applicable rule for small storage tanks so enter the rule number as “none”. Do not check the TAC/ODC box. Enter the application number associated with the permit. Enter 0.4885 (see below) as the emission factor for organic gasses. Enter an emission factor of 0.0 for all other air contaminants and add the record.**

$$EF = 103.8 \text{ lb VOC/yr} / 212.5 \text{ Mgal/yr} = 0.4885 \text{ lb/Mgal}$$

$$Q = 212.5 \text{ Mgal/yr}$$

## **Internal Floating Roof Tanks (Form B6)**

**Example 4:**

An external floating roof tank 76 feet in diameter is made of welded steel with a capacity of 175,000 gallons and has a pontoon-type roof. The tank was used all year to store 6,500,000 gallons of gasoline (RVP 7). The noted Appendix 2 is found in the Supplemental Instructions for Liquid Organic Storage Tanks and References.

Avoid all comma separators when entering data.

- Step1: Select Form B6 in the AER web-based application in Form Data Entry
- Step 2. Click the down arrow and select “add new Tank Description”
- Step 3. Wait for pop-up box and enter in the tank description as an internal floating roof tank with a bolted deck

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- Step 4. Click down arrow and select the product code from the list
- Step 5. Enter product description as crude oil
- Step 6. Enter tank ID E1
- Step 7. Enter tank capacity, C, in 1,000 of gallons (Mgal) 175
- Step 8. Enter tank diameter, D, (ft) 76
- Step 9. Enter annual throughput, Q, in 1,000 of gallons (Mgal) 6500
- Step 10. Check the TAC/ODC box (gasoline contains toxic compounds)
- Step 11. Fill in the associated application no. or click on the magnifying glass and select the application number with a check mark, select O.K.
- Step 12. Enter the roof support factor,  $N_C$  [Appendix 2] 0.0
- Step 13. Enter rim-seal loss factor,  $K_R$  [Appendix 2] 20.1
- Step 14. Enter total roof fitting loss factor,  $F_F$  [Appendix 2] 1691.8
- Step 15. Enter deck seam loss factor,  $K_D$  [Appendix 2] 0.0
- Step 16. Enter deck seam length factor,  $S_D$  [Appendix 2] 0.0
- Step 17. Enter evaporative loss from upset,  $L_x$  (lb), no upset losses 0.0

All other necessary factors and calculations are provided for you.

**Do not forget to add the toxic air contaminant(s) to Form TAC.**

**B6 - Permitted Internal/External Floating Roof Tank Calculation Sheet**

☐ The Data is Imported from the EPA Tank4 Application

Tank Description: **add new Tank Description...** External Floating Roof Tank, Pontoon

Product Code (See Supplemental Inst. Book): **7. Gasoline (RVP 7)**

Product Description: **Gasoline**

Tank ID Number: **E1**

Max. Storage Capacity, C, (1000 gallons): **175**

Tank Diameter, D, (ft): **76**

Annual Throughput, Q, (1000 gallons): **6500**

Vapor Molecular Weight,  $M_v$ , (lb/lb mole): **68**

Liquid Density,  $W_L$ : **5.50**

Material True Vapor Pressure,  $P_{va}$ : **3.880**

Pressure Function,  $F_p$ : **0.076**

Shell Clingage Factor,  $S_c$  (0.006 for crude oil; 0.0015 for others): **0.0015**

TAC/ODC: ☒

Application Number: **444333**

Product Factor,  $K_p$ : **1.0**

Rim Seal Loss Factor,  $K_R$ : **20.1**

Roof Fitting Loss Factor,  $F_F$ : **1691.8**

Deck Seam Loss Factor,  $K_D$ : **0.0**

Deck Seam Length Factor,  $S_D$ : **0.0**

Calculated Working Loss,  $L_w$ , (lbs/yr): **16.13**

Calculated Rim Seal Loss,  $L_R$ , (lbs/yr): **7,894.64**

Calculated Deck Fitting Loss,  $L_F$ , (lbs/yr): **8,743.22**

Calculated Deck Seam Loss,  $L_D$ , (lbs/yr): **0.00**

Total Excess Emission From Upsets,  $L_x$ , (lbs/yr): **0.0**

Calculated Total Loss,  $L_T$  (lbs/yr): **16653.989**

**ADD RECORDS** **CANCEL**

\* Required Fields  
Do not include comma in numeric fields.

## **Internal Floating Roof Tanks (Form B6)**

### **Example 5:**

An internal floating roof tank with a vapor-mounted resilient seal (primary seal) and rim-mounted secondary seal in good condition is 64 feet in diameter. The tank is lightly rusted and covered by a welded steel deck. Stored product: Crude Oil; 593,125 bbl throughput for the reporting period (42 gals/bbl \* 593,125 bbl = 24,911,250 gal). Maximum Tank Capacity for this tank is 2,800,000 gallons. The tank was used to store crude oil all year. The noted Appendix 2 is found in the Supplemental Instructions for Liquid Organic Storage Tanks and References.

**Avoid all comma separators when entering data.**

- |          |  |          |
|----------|--|----------|
| Step 1:  | Select Form B6 in the AER web-based application in Form Data Entry   |          |
| Step 2:  | Click the down arrow and select "add new Tank Description"   |          |
| Step 3:  | Wait for pop-up box and enter in the tank description as an internal floating roof tank with a bolted deck                               |          |
| Step 4:  | Click down arrow and select the product code from the list   |          |
| Step 5:  | Enter product description as crude oil   |          |
| Step 6:  | Enter tank ID  | E3       |
| Step 7:  | Enter tank capacity, C, in 1,000 of gallons (Mgal)   | 2800     |
| Step 8:  | Enter tank diameter, D, (ft)   | 64       |
| Step 9:  | Enter annual throughput, Q, in 1,000 of gallons (Mgal)   | 24911.25 |
| Step 10: | Check the TAC/ODC box (crude oil contains toxic compounds)   |          |
| Step 11: | Fill in the associated application no. or click on the magnifying glass and select the application number with a check mark, select O.K. |          |
| Step 12: | Enter the roof support factor, $N_C$ [Appendix 2]  | 0.016    |
| Step 13: | Enter rim-seal loss factor, $K_R$ [Appendix 2]   | 6.7      |
| Step 14: | Enter total roof fitting loss factor, $F_F$ [Appendix 2]   | 366.5    |
| Step 15: | Enter deck seam loss factor, $K_D$ [Appendix 2]  | 0.14     |
| Step 16: | Enter deck seam length factor, $S_D$ [Appendix 2]  | 0.20     |
| Step 17: | Enter evaporative loss from upset, $L_x$ (lb), no upset  | 0.0      |

All other necessary factors and calculations are provided for you.

**Do not forget to add the toxic air contaminant(s) to Form TAC.**

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AER FormB6 - Windows Internet Explorer provided by South Coast A.Q.M.D.

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**B6 - Permitted Internal/External Floating Roof Tank Calculation Sheet**

☐ The Data is imported from the EPA Tank4 Application

Tank Description: **add new Tank Description...** Internal Floating Roof Tank, Welded Deck

Product Code (See Supplemental Inst. Book): **1. Crude oil (RVP 5)**

Product Description: **Crude Oil**

Product Factor K: **0.4**  
(0.4 for crude oil; 1.0 for others)

Tank ID Number: **E3**

Roof Support Factor, N: **0.016**

Max. Storage Capacity, C, (1000 gallons): **2800**

Rim Seal Loss Factor, K<sub>R</sub>: **6.7**

Tank Diameter, D, (ft): **64**

Roof Fitting Loss Factor, F<sub>R</sub>: **366.5**

Annual Throughput, Q, (1000 gallons): **24911.25**

Deck Seam Loss Factor, K<sub>D</sub>: **0.14**

Vapor Molecular Weight, M<sub>w</sub>, (lb/lb mole): **50**

Deck Seam Length Factor, S<sub>D</sub>: **0.2**

Liquid Density, W<sub>L</sub>: **7.10**

Calculated Working Loss, L<sub>w</sub>, (lbs/yr): **378.21**

Material True Vapor Pressure, P<sub>va</sub>: **3.181**

Calculated Rim Seal Loss, L<sub>R</sub>, (lbs/yr): **523.14**

Pressure Function, F<sub>p</sub>: **0.061**

Calculated Deck Fitting Loss, L<sub>f</sub>, (lbs/yr): **447.13**

Shell Clnage Factor, S<sub>c</sub> (0.006 for crude oil; 0.0013 for others): **0.006**

Calculated Deck Seam Loss, L<sub>D</sub>, (lbs/yr): **139.92**

TAC/ODC: ☒

Total Excess Emission From Upsets, L<sub>u</sub>, (lbs/yr): **0.0**

Application Numbers: **444111**

Calculated Total Loss, L<sub>T</sub>, (lbs/yr) (L<sub>w</sub>+L<sub>R</sub>+L<sub>f</sub>+L<sub>D</sub>+L<sub>u</sub>): **1488.4**

\* Required Fields

Do not include comma in numeric fields.

**ADD RECORDS** **CANCEL**

Done

Local intranet | Protected Mode: Off

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## **Fixed Roof Tanks (Form B7)**

### Example 6:

A fixed roof domed tank; 20 ft in diameter and 18 feet tall, is in good condition and stores 3,900,000 gallons of gasoline (RVP 10) for the reporting period. Tank capacity is 42,000 gallons (42 Mgal). The tank was used to store gasoline 256 days in a year and controlled by a vapor recovery system at 96.7 percent efficient. During this reporting period, an upset in the process caused an evaporative loss of 1,200 pounds of gasoline.

Avoid all comma separators when entering data.

- |          |  |        |
|----------|--|--------|
| Step 1:  | Select Form B7 in the AER web-based application in Form Data Entry   |        |
| Step 2:  | Click the down arrow and select "add new AER device"   |        |
| Step 3:  | Wait for pop-up box and type in the tank description as a domed tank   |        |
| Step 4:  | Click down arrow and select the product code from the list   |        |
| Step 5:  | Enter product description as gasoline  |        |
| Step 6:  | Enter tank ID  | E3     |
| Step 7:  | Enter tank capacity, C, in 1,000 of gallons (Mgal)   | 42.0   |
| Step 8:  | Enter tank diameter, D, (ft)   | 20.0   |
| Step 9:  | Enter tank height, H, (ft)   | 18.0   |
| Step 10: | Enter annual throughput, Q, in 1,000 of gallons (Mgal)   | 3900.0 |
| Step 11: | Enter the number of days of use, U   | 256    |
| Step 12: | Check the TAC/ODC box (gasoline is toxic)  |        |
| Step 13: | Fill in the associated application no. or click on the magnifying glass and select the application number with a check mark, select O.K. |        |
| Step 14: | Enter evaporative loss from upset, L <sub>x</sub> (lb)   | 1200   |
| Step 15: | Enter the control system efficiency in decimal form  | 0.967  |

All other necessary factors and calculations are provided for you.

Do not forget to add the toxic air contaminant(s) to Form TAC.

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**B7 - Permitted Fixed Roof Tank Calculation Sheet**

☐ The Data is Imported from the EPA Tank4 Application

Tank Description: **add new AER device...**  
**Fixed Roof Tank with Domed Roof**

Product Code (See Supplemental Inst. Book): **10. Gasoline (RVP 10)**  
 Product Description: **Gasoline**

Tank ID Number: **E3**  
 Tank Capacity, C, (1000 gallons): **42**  
 Tank Diameter, D, (ft): **20**  
 Tank Height, H, (ft): **18**  
 Annual Throughput, Q, (1000 gallons): **3900.0**  
 Usage, U (Number of Days tank used in a year; default = 365 days): **256**

Vapor Molecular Weight, Mw: **66**  
 Vapor Density, Wv: **0.067**  
 Material True Vapor Pressure, Pva: **5.744**  
 Vapor Space Expansion Factor, Kv: **0.143**  
 Vapor Saturation Function A, Sa: **0.1922**

TAC/ODC: ☒  
 Application Number: **444222**

Calculated Values:

- Vapor Saturation Function B, Sb: **0.0209**
- Working Loss Product Factor, Kw (0.75 for crude oil; 1.0 for Others): **1.0**
- Vapor Space Function, Vv: **430**
- Calculated Throughput/Capacity (Q/C) Ratio: **92.8571428**
- Calculated Turn Over Factor, Kt: **0.48974356**
- Calculated Vapor Space Volume, Vv: **3237.28**
- Calculated Vapor Saturation Factor, Ks: **0.24062337**
- Calculated Working Loss, Lw (lbs/yr): **17378.1273**
- Calculated Standing Loss, Ls (lbs/yr): **1909.80208**
- Total Excess Emission From Upsets, Lx (lbs/yr): **1200**
- Total Loss Without Control System, Lt (lbs/yr) (Lw+Ls+Lx): **20487.9294**
- Control System Efficiency (decimal fraction): **0.967**
- Total Loss with Control System, (lbs/yr): **1836.50167**

## Emissions from Storage of Non-VOC Pure Exempt and Toxic Materials

For a products that is a pure exempt compound and is toxic, use an appropriate example from above (underground, aboveground, floating or fixed roof) to determine the toxic emissions. Organic gasses will be zero. Example 7 provides sample methodology.

### Example 7:

An aboveground 8,500 gallon storage tank with a diameter of 8 feet contains methylene chloride and undergoes 5 changes per year. It is vented to a control device that operates continuously at 90% control. Calculate the annual losses.

$$f = 12.912 \text{ lbs/gal (See " [Loss Factors for Small Storage Tanks](#) ")}$$

$$Q = 42.5 \text{ Mgal/yr}$$

$$a, b = 0.449, 0.168 \text{ (See " [Loss Factors for Small Storage Tanks](#) ")}$$

$$D^* = 8 \text{ ft}$$

$$H = 7 \text{ ft}$$

$$L_w = (12.912 \text{ lb/gal})(42.5 \text{ Mgal/yr})(1-0.90) = 54.9 \text{ lb/yr}$$

$$L_s = \frac{0.449 * 7 * 8^2}{(1 + 0.168 * 7)} (1 - 0.90) = 9.244 \text{ lb / yr}$$

$$L_T = 54.9 + 9.2 = 64.1 \text{ lb VOC/yr}$$

$$EF = 64.1 \text{ lb VOC/yr} / 42.5 \text{ Mgal/yr} = 1.51 \text{ lb/Mgal controlled}$$

**Select Form B4 in the web-based application and enter the data on Form B4. Select the activity code of 2D from the drop down list, and select the unit code of 1000 gallons from its drop down list. Enter the throughput as 42.5. Enter the applicable rule number as 1401. Check the TAC/ODC box. Enter the application number associated with the permit. Enter an emission factor of 0.0 for all air contaminants and add the record.**

**Go to Form TAC and:**

1. Select the TAC Row as B4-1 (If row 1)
2. Select the TAC Code as number 16 (Methylene Chloride)
3. Enter the Annual Usage as 42.5 Mgal
4. Select the Units number 4 (1000 gallons)
5. Enter the Application Number associated with the permit
6. Enter the Controlled Emission Factor as 1.51 lb/Mgal
7. Enter the Control Efficiency as 0.0 (the emission factor already includes the effects of control)

The calculation is performed for you.